

REMARKS

This amendment is in response to the Office Action dated September 4, 2001 in the above referenced patent application. A petition for a three month extension of time for response is submitted herewith.

The specification has been amended to remove the words "an isotropic." Claims 5, 12, and 24 to 28 have been cancelled. Claims 1-4, and 6-11 are currently pending in the application.

Claim 1 has been amended to more particularly claim features of the present invention. Support for these amendments are found in the specification and in the original claims. Applicant respectfully submits that no new matter is added by this amendment.

Rejections Under 35 U.S.C. §112

The Examiner rejects claims 24 to 28 and the specification under 35 U.S.C. 112 first paragraph and 35 U.S.C. 132. Applicant has deleted the word "isotropic" in the specification and has canceled claims 24 to 28. Accordingly, Applicant respectfully submits that these rejections be withdrawn.

Rejections Under 35 U.S.C. § 102

The Examiner rejects Claims 1 and 8 under 35 U.S.C. § 102(b) as being anticipated by McDiarmid, and Claims 1, 2, 5 and 8 under 35 U.S.C. § 102(e) as being anticipated by MacLeish *et al.* Applicant respectfully submits that the claimed invention is patentable over McDiarmid and MacLeish.

An anticipation rejection requires that a single reference expressly or inherently disclose each and every element of a claim. *In re Paulsen*, 31 USPQ2d 1671, 1673 (Fed. Cir. 1994); MPEP § 2131 (citing *Richardson v. Suzuki Motor Co.*, 9 USPQ2d 1913, 1920 (Fed. Cir. 1989)).

McDiarmid describes a support means having a curvilinearly shaped cavity in one surface for supporting a wafer in a cavity. McDiarmid teaches that the susceptor is made of graphite. McDiarmid states that as the wafer is heated, a temperature gradient exists between the top and

bottom surface on the susceptor which cause the wafer to bow, col. 5, lines 12-24. McDiarmid also states that bowing of the wafer causes the wafer edges to lose physical contact with the susceptor, col. 3, lines 35-43. Applicant contends that McDiarmid does not maintain contact substantially entirely around the peripheral edge of the substrate during processing at elevated temperatures are required in Applicant's claims. In fact, McDiarmid goes to great lengths to accommodate the bowing of the wafer while attempting to maintain uniform heating of the wafer by specifically sizing the side wall height, cols. 5 and 6, particularly lines 50 to 68 of col. 5. McDiarmid focuses on accommodating the bowing and consequent loss of physical contact with the susceptor. McDiarmid does not describe or suggest a susceptor design which prevents the loss of physical contact with the wafer.

In great contrast, the claimed invention provides a wafer carrier which maintains physical contact with the substrate along the peripheral edge of the substrate throughout processing at elevated temperatures. Applicant respectfully submits that the graphite susceptor of McDiarmid (and MacLeish) is not capable of such a requirement. Graphite just cannot provide the dimensional stability needed to meet the recited limitations of the claimed invention. Graphite is much less predictable during heating, McDiarmid seeks to accommodate the bowing and consequent loss of physical contact with the susceptor, McDiarmid does not provide any motivation to seek a wafer carrier design that maintains the physical contact with the susceptor during heating. Moreover, graphite is relatively inexpensive and easy to fabricate and process. The materials that meet the limitations of Applicant's claims, by contrast, such as silicon carbide, are much more expensive and very difficult to fabricate and process. Graphite is very soft, while silicon carbide often requires diamond tipped tools to process.

MacLeish *et al.* teach that RF energy couples to silicon carbide coated graphite dish 32 to heat wafer 52 from above, and to graphite susceptor 50 to heat wafer 52 from below. *See, e.g.*, (col:ln) 5:59-63. In MacLeish, the susceptor is made from graphite to absorb RF radiation from the induction coils to heat the wafer. The MacLeish susceptor is not thermally expansion matched to the wafer and thus is subject to causing detrimental relative movement between the wafer and susceptor during heating and cooling, unlike the susceptor of the present invention.

Further, MacLeish states at column 5, lines 5 to 10 that "the top surface of susceptor 50 is

recessed such that a minimum number of points along the outer edge of wafer 52 need be in intimate contact with susceptor 50 while wafer 52 rests thereon, thereby minimizing conductive heat transfer between susceptor 50 and wafer 52" (emphasis added).

Applicant respectfully submits that MacLeish teaches away from the present invention. MacLeish teaches one to minimize the number of points in contact with the wafer, unlike Applicant's claims which recite support around the entire periphery edge. MacLeish does not disclose by what minimum number of points the wafer is supported, and the Examiner has stated that this could be along the entire periphery. Applicant respectfully disagrees. The wafer could be supported by as few as three points along its outer edge, and the plain language used by MacLeish would suggest that a minimum number of points along the outer edge means less than the entire periphery. This is further supported by MacLeish's teaching to minimize heat transfer to the wafer. As such, the susceptor in MacLeish would permit backside deposition. Moreover, MacLeish motivates one to minimize conductive heat transfer between the wafer and the substrate. The present invention seeks to maximize it. Applicant respectfully submits that the present invention is neither anticipated or obvious in light of MacLeish.

Rejections Under 35 U.S.C. § 103(a)

The Examiner rejects the claims under 35 U.S.C. § 103(a) as being obvious over McDiarmid and MacLeish *et al.* based primarily on arguments regarding the selection of certain dimension. Applicant traverses these rejections and submits that the amended claims are patentable over the cited art.

When rejecting claims under 35 U.S.C. § 103, the Examiner bears the burden of establishing a *prima facie* case of obviousness. *See, e.g., In re Bell*, 26 USPQ2d 1529 (Fed. Cir. 1993); M.P.E.P. § 2142. To establish a *prima facie* case, three basic criteria must be met: (1) the prior art must provide one of ordinary skill with a suggestion or motivation to modify or combine the teachings of the references relied upon by the Examiner to arrive at the claimed invention; (2) the prior art must provide one of ordinary skill with a reasonable expectation of success; and (3) the prior art, either alone or in combination, must teach or suggest each and every limitation of the rejected claims. The

teaching or suggestion to make the claimed invention, as well as the reasonable expectation of success, must come from the prior art, not Applicant's disclosure. *In re Vaeck*, 20 USPQ2d 1438 (Fed. Cir. 1991); M.P.E.P. § 706.02(j). If any one of these criteria is not met, *prima facie* obviousness is not established.

As discussed above McDiarmid and MacLeish fail to teach or suggest each and every element of the claimed invention. Moreover, there is no motivation to modify MacLeish to arrive at the claimed invention. The prior art references teach a susceptor made from graphite, which does not have the thermal effect as recited by Claim 1. Applicant would like to point out that the wafer carriers of McDiarmid and MacLeish are comprised of graphite for an important reason - graphite acts as a conductor to couple RF heating to the wafer carrier. Substituting a material as recited in Applicant's claims would defeat the intended purpose of the wafer carriers in McDiarmid and MacLeish. Further, the graphite susceptors of the prior art are not suited for the wafer carrier of the present invention, because the CVD processing environment employed in the present invention would readily oxidize a graphite susceptor. Finally, graphite has anisotropic thermal properties which result in unpredictable thermal effects, particularly thermal expansion which is orientation dependent and difficult to control, and is thus not suitable for supporting a wafer around its entire periphery edge as recited in Applicant's claims. Thus, the selection of one material over another is not a simple, or obvious matter.

Applicant respectfully submits that the specific dimensions of certain features add nothing to the teaching of MacLeish and McDiarmid. Applicant contends that the same is true for the cited references of Grabmaier, Inoue, Haafkens and Chen.

More specifically, Grabmaier describes a highly pure semiconductor carrier material which is the same material as the semiconductor being processed in order to minimize impurities in the making of precipitated single crystalline semiconductor layers. Applicant respectfully submits that this is an entirely different process. No where does Grabmaier teach a wafer carrier where a substrate is supported by the wafer carrier only around a peripheral edge of the substrate and a backside of the substrate does not contact the recessed bottom surface, and where the wafer carrier is comprised of a material having a coefficient of thermal expansion which enables the upwardly inclined surface to maintain contact substantially entirely around the peripheral edge of the substrate during

processing at elevated temperatures as recited in Applicant's claims. Grabmaier is focused on contamination issues only. Applicant respectfully submits that there is no motivation in Grabmaier to modify the shape of the carrier to that of McDiarmid.

Moreover, the mere fact that a reference can be modified does not render the resultant modification obvious unless the prior art also suggested the desirability of the modification. *In re Mills*, 16 USPQ2d 1430 (Fed. Cir. 1990).

Chen *et al.* do not make up for the deficiencies of MacLeish *et al.* Chen is directed at a graphite susceptor which has a coating that closely matches the thermal coefficient of the graphite in order to prevent cracking of the coating, and thus has similar limitations as discussed above. Chen does not teach or suggest matching the thermal coefficient of the susceptor and wafer.

Moreover, Chen appears to contact the backside of the wafer. At col. 3, lines 37 to 57, Chen defines a substrate mounting surface 32 by the base edge 37 of beveled side 36 of lip 34. In one embodiment for a 200mm wafer, the edge 37 define a substrate mounting surface diameter of approximately 8". Rounded edges are used to reduce the stress on the wafer edge during thermal cycling. Thus, Chen does not support the wafer only around its entire periphery edge as recited in Applicant's claims. Even if one were to combine MacLeish and Chen, one would not arrive at Applicant's invention.

Inoue describes a round, flat wafer holder made of blackened aluminum nitride. The motivation of Inoue is to increase the absorption of light of wavelength emitted by halogen lamps in order to increase the heat transfer to the wafer. The wafer carrier of Inoue contacts the entire backside of the wafer which appears to be required for uniform heating of the wafer in this application. Applicant respectfully submits that if the wafer carrier of Inoue were to be modified to add the recess of McDiarmid as suggested by the Examiner, then the heat transfer would be significantly changed and the intended purpose of Inoue would be lost.

Haafkens focuses on a machining operation which provides mechanical stresses which are supposed to compensate each other, thus ensuring that a substrate carrier remains flat after a coating has been applied. Applicant respectfully submits that the teaching of Haafkens is limited to machining techniques for minimizing warpage of a material during fabrication. Haafkens does not describe or teach a wafer carrier with an upwardly inclined surface that maintain contact substantially

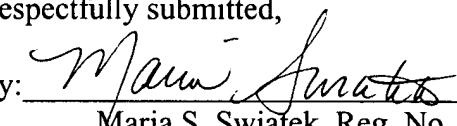
entirely around the peripheral edge of the substrate during processing at elevated temperatures as recited in Applicant's claims.

Further, Applicant respectfully submits that the prior art references do not teach or suggest a wafer having a flat edge region with a width of approximately 5 to 25 mm as recited in Applicant's amended claims. As discussed in the present specification at the top of page 6, this flat edge region acts to minimize the edge effect. The specific dimensions of this flat edge region are dependent on many factors and are not a matter of simple design. For example, the pressure, temperature and flow rates of the various gases all impact the gas flow dynamics at the wafer surface and the resultant uniformity of the deposited film. This will vary greatly depending upon the particular CVD process. For example, McDiarmid and MacLeish employ RF energy and the CVD processes are carried out lower pressures, whereas the present invention is carried out at atmospheric pressure. This results in very different gas flow dynamics, and Applicant respectfully submits that the dimensions recited in Applicant's claims are in no way an obvious choice. Applicant submits that the prior art references do not disclose, teach or suggest the above limitations. For the foregoing reasons, Applicants respectfully submit that the pending claims are novel and non-obvious over the cited references singularly or in combination. An early notice of allowance of all claims is respectfully requested.

If any matters can be handled by telephone, Applicants requests that the Examiner telephone Applicants' attorney at the number below.

The Commissioner is authorized to charge any additional fees, including fees for extension of time, to Deposit Account No. 06-1300 (Order No. A-64873-1/AJT/MSS).

Respectfully submitted,

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VERSION WITH MARKINGS TO SHOW CHANGES MADE

IN THE SPECIFICATION:

The paragraph beginning at page 7, line 3, has been amended as follows:

To maintain the desirable line or point contact with the peripheral edge of the wafer and to provide secure support of the wafer, the thermal expansion of the wafer carrier is considered. Preferably, little thermal expansion occurs during the process so that the desired angle of the incline is preserved. Specifically, the wafer carrier is comprised of a material having [an isotropic] coefficient of thermal expansion in the range of $2.6 \times 10^{-6}/^{\circ}\text{C}$ to $5 \times 10^{-6}/^{\circ}\text{C}$, with the lower values preferred. Materials with suitable coefficients of thermal expansion include silicon and silicon carbide.

IN THE CLAIMS:

Claim 1 has been amended as follows:

1. (Amended) A wafer carrier for supporting a substrate, comprising:

a circular plate having a flat edge region extending around the circumference of said plate, said flat edge region having a width of approximately 5 to 25 mm; and

a circular recessed center region having a recessed bottom surface and including an upwardly inclined surface around the periphery of said recessed bottom surface,

wherein the substrate is supported by a portion of the upwardly inclined surface and is spaced apart from said recessed bottom surface, and the upwardly inclined surface is inclined at an angle in the range of approximately 5 to 45 degrees to the plane of the recessed bottom surface such that the substrate is supported by said wafer carrier only around a peripheral edge of the substrate and a backside of the substrate does not contact the recessed bottom surface, and

wherein said wafer carrier is comprised of a material having a coefficient of thermal

expansion in the range of 2.6×10^{-6} to 5×10^{-6} / °C [that] which enables the upwardly inclined surface to maintain contact substantially entirely around the peripheral edge of the substrate during processing at elevated temperatures [, whereby] such that deposition on [a] the backside of the substrate is substantially prevented.

Cancel Claim 5.

Cancel Claim 12.

Cancel Claims 24 to 28.